



Niche Market Workshop

May 20, 2003

How do you see the future?





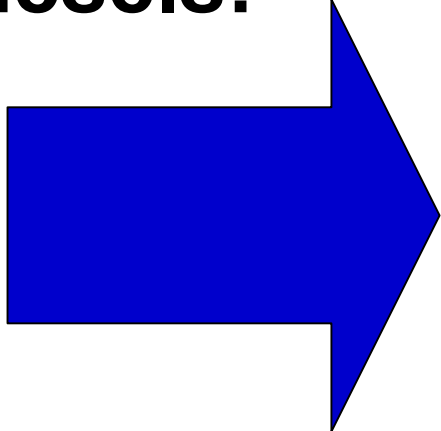
Powering the Planet - Protecting the Dream





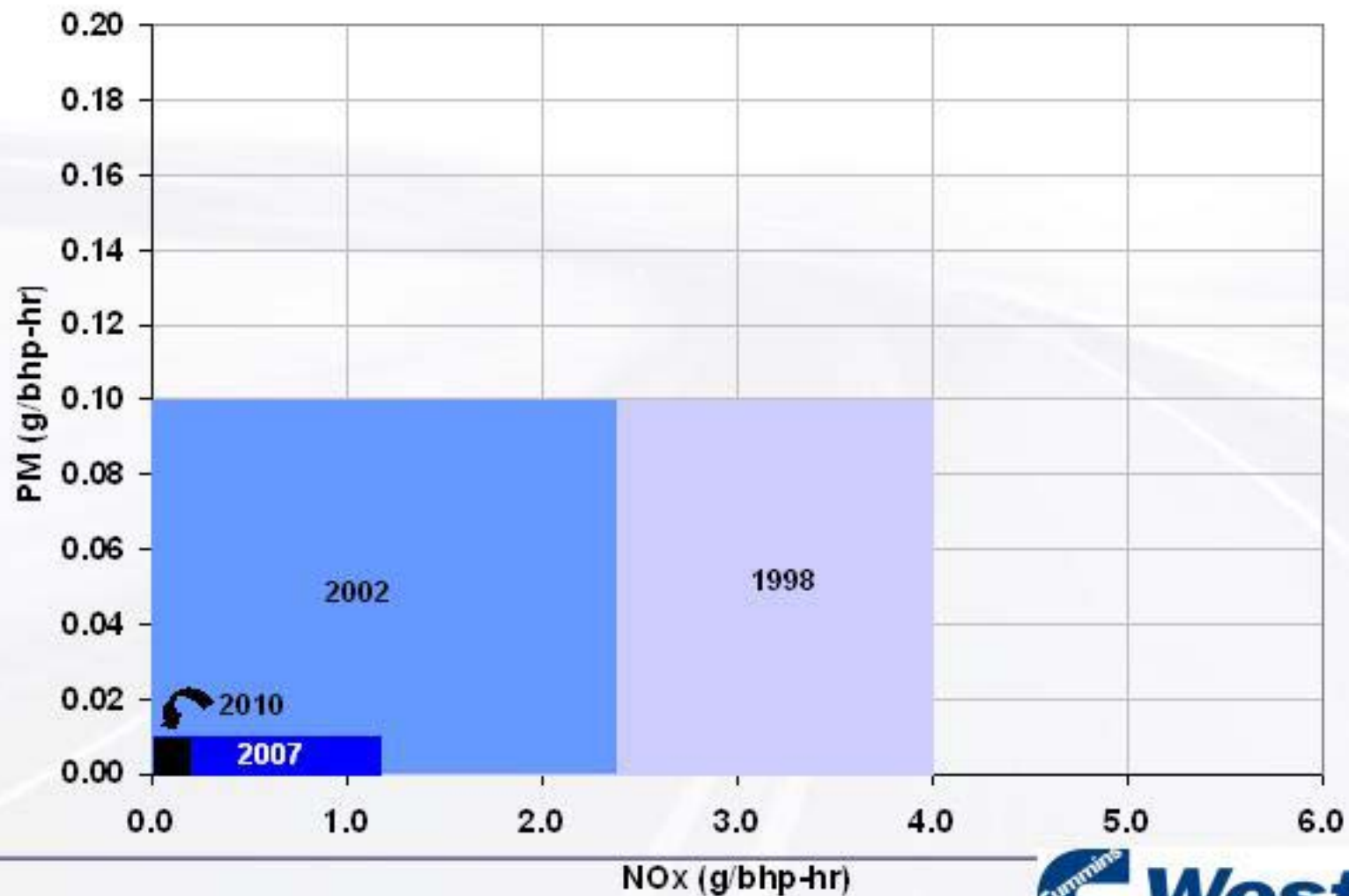
THE CUMMINS DIESEL
*"Twice as Far for
Half as Much"*

Emissions Laws Will Get Tougher

- **This is a big deal for diesels!**
 - More expensive
 - More complex
 - Reduced fuel economy
 - Reduced performance
 - Hard to see a technology road map beyond 2010
- 
- Started
10/02**



US HD Truck Standards



No easy solutions..Sooner or later

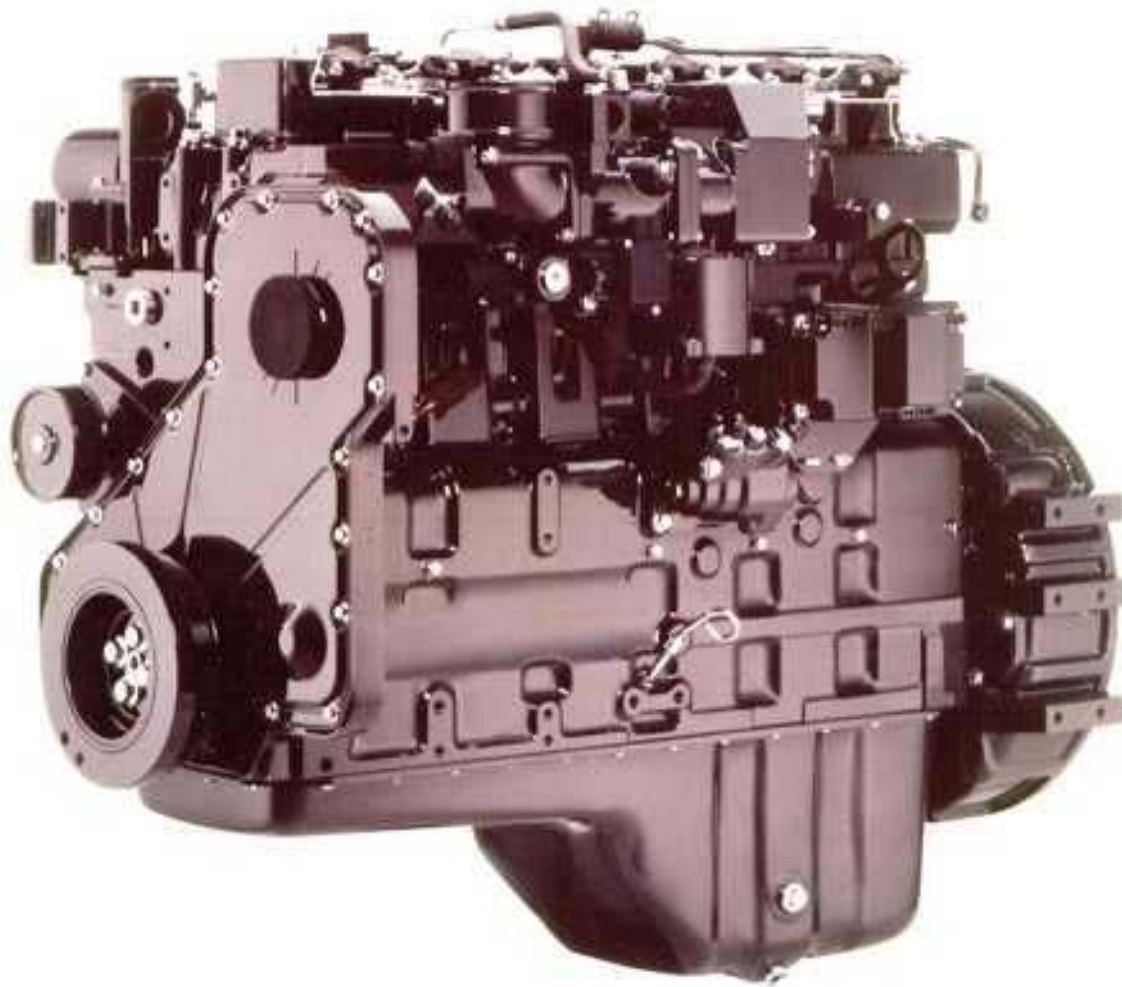
In-cylinder – Exhaust Gas Recirculation (EGR)	Introduced on Light-Duty, coming on Heavy-Duty for EPA 2002, improves NOx, worsens PM
In-cylinder – Change the fuel	Synthetic fuels; biofuels; water blends; expensive, limited emissions reduction
In-cylinder - Change the operating cycle to spark ignition or dual fuel	Highly effective in many applications but do not match diesel performance and efficiency.
External - Clean up the exhaust	No good solution for NOx today. Affects durability and efficiency. Will be needed by end of decade.
Change to new technologies – fuel cells, hybrids	If all technical and infrastructure issues resolved, high costs remains a problem, especially in commercial applications

The JV's Mission

Big in Clean Power

- A. Make the existing spark-ignited natural gas business work today**
- B. Develop the new Westport HPDI Technology for the future**

C Gas Plus



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C Gas Plus Ratings

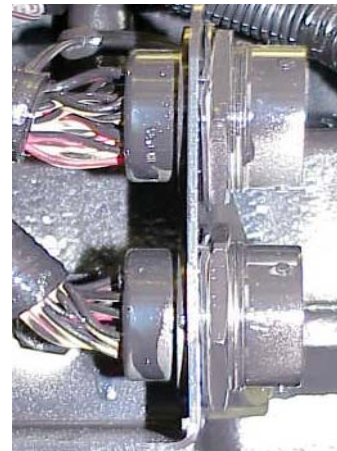
<u>Model</u>	<u>Horsepower</u>	<u>Peak Torque</u>
C Gas Plus 280	280 @ 2400	850 @ 1400 (971)*
C Gas Plus 275	275 @ 2400	750 @ 1400 (857)*
C Gas Plus 250	250 @ 2400	660 @ 1400 (754)*

* - Note, when vehicle is geared properly at 2400 RPM with the same road speed as a 2100 RPM engine, the effective torque is increased as noted

Why the C Gas Plus is Better

- **By Design**

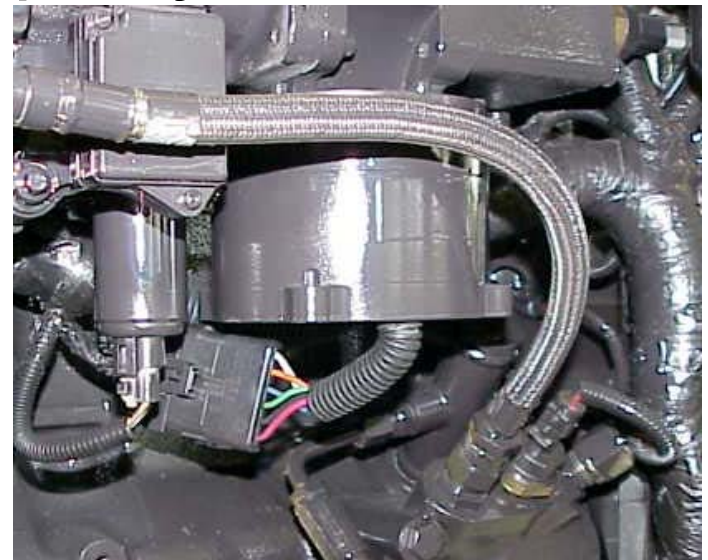
- Engine back pressure compensation
- Fuel supply pressure is measured
- Cooling fan drive available
- IMT monitor and protection
- Supply voltage is measured
- J1939 datalink
- Diesel-like wiring
- Diesel-like features



Why the C Gas Plus is Better

- **By Design**

- No Woodward governor
- Wide range fuel composition capability
- Knock sensing and control
- Robust Oxygen sensor design
- Improved oil consumption
- Improved throttle actuator
- Adaptive learn
- Modern engine controller
- Improved controls
- More sensed parameters
- Humidity sensing and compensation(Late '02)



Cummins B Gas Plus B LPG Plus



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B Plus Plus Ratings

<u>Model</u>	<u>Horsepower</u>	<u>Peak Torque</u>
B Gas Plus 230	230 @ 2800	500 @ 1600
B Gas Plus 200	200 @ 2800	465 @ 1600
B Gas Plus 195	195 @ 2800	420 @ 1600
B LPG Plus	195 @ 2800	420 @ 1600

L Gas Plus Development

- Cummins 8.9 litre ISL engine will be launched using “C Plus” engineering
- 320 horsepower rating
- Available 2004
- Aimed at urban transit and trucks needing more power than the C Gas Plus



Plus Engine Diagnostics

Insite



Assists mechanics to quickly program engine, analyze faults & troubleshoot engines

Cummins QuickCheck

- **PalmPilot handheld device to:**
 - **Displays SAE fault code information**
 - **View sensor output data**



Plus Engine “Watch Outs”

- **Driveline Match -- Converter and Axle Ratio**
- **Idle Time**
- **Planned Altitude**
- **Oil Specification**
- **Grams Vs. Tons**

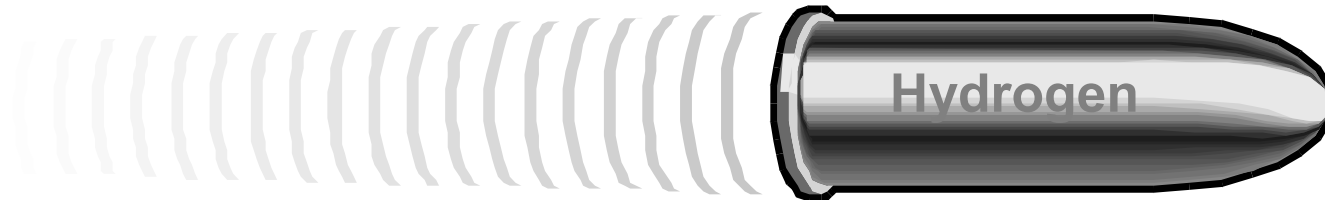
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A Hydrogen Future ??

H to H₂O

Hydrogen is a Cool Idea...but

The Silver Bullet of Alternate Technologies...May be Pretty Slow



Hydrogen is very compelling, but issues like economics / technology / availability = TIME



Hydrogen Blended Natural Gas Fuel (HCNG)

- **Influences Combustion**
- **Influences Torque and Thermal Efficiency**
- **Extends Lean Burn Natural Gas Limits**
- **Reduce Greenhouse Gases**
- **Hythane**



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T h e F u t u r e i s C l e a r

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